

Intermediate report:

Financing framework for meshed offshore grid investments

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1 INTRODUCTION

Offshore wind power is expected to play a key role towards the decarbonisation of the European energy system and its key enabler, a strong and secure offshore grid, is a widely recognised prerequisite to reach the European energy and climate policy targets for a competitive, secure and sustainable energy system. A meshed offshore grid (MOG) in the Northern Seas, in particular, has been recognised by the European Commission (EC) as one of the priority electricity corridors to ensure an integrated European energy market (Directorate General for Energy, 2010). The current situation in the North Seas, however, includes radial connections of offshore wind farms to shore and offshore interconnectors with three main parties investing in offshore electricity transmission lines: the national Transmission System Operators (TSOs), private investors in jurisdictions that allow private Offshore Transmission Owners (OFTOs) (exclusively in UK) and the offshore wind farm (OWF) generators. Little progress has been made so far towards a fully integrated offshore grid in the North Sea mainly due to legal, regulatory, financial and market barriers.

The aim of working package WP7.3 is to identify and propose appropriate recommendations to facilitate investments in a meshed offshore electricity transmission grid in the North Sea. Based on research on the current financing of onshore and offshore electricity transmission grids in the European Union (EU), the investigation and comparison with international practices and the identification of the main financial challenges and investment barriers, a set of recommendations will be developed to overcome these challenges and the investment gaps.

The intermediate report of WP7.3 for stakeholder consultation investigates the current financing practices of onshore and offshore electricity transmission investments in the EU and examines their suitability for investments in a meshed offshore grid. In particular, the report focuses on the following five topics:

- Chapter 2 provides an overview of the challenges arise regarding the financing of meshed offshore grids.
- Chapter 3 highlights the investment volumes for electricity transmission grids as well as the investment gap, as estimated by EC and other studies. The national plans for investments in offshore transmission networks are also presented. Moreover, the investor models and their responsibilities are described. The investor type and the drivers for investing in offshore electricity transmission grids are presented.
- Chapter 4 describes the characteristics of the national regulatory frameworks for electricity transmission investments onshore and offshore. An overview of the EU investment framework developed to support key energy infrastructure investments is provided.
- Chapter 5 focuses on the financing structures and financial sources used by the TSOs and private investor. Practical examples of investments in OWF grid connections and offshore interconnectors are presented.
- Chapter 6 presents the conclusions of the analysis and provides some initial ideas for the further discussion on the recommendations for the development of appropriate financing strategies suitable for investments in a MOG in the North Sea.



2 FINANCING CHALLENGES OF AN INTEGRATED OFFSHORE GRID

A fully interconnected offshore electricity grid in the Northern Seas¹ represents a high investment value for Europe, as it contributes to the higher integration of renewable energy (RE), the increase of the cross-border power trading and thus, the energy security and the decrease of energy imports outside the EU (Gaventa, 2014). Additionally, the development of a common integrated offshore grid in the Northern Seas could reduce the capital costs for individual Member States through economies of scale and contribute to the stabilization of the consumer prices (Directorate General for Energy, 2010). A study from EC on the benefits of a MOG in Northern Seas has estimated annual savings in 2030, including costs of losses, CO₂ emissions and generation savings, between EUR 1.5 and 5.1 billion for coordinated offshore development (Tractabel Engineering, GDF Suez, Ecofys, & PWC, 2014). Due to all aforementioned potential benefits, EC has identified the development of a MOG in the Northern Seas as one of the main electricity priority corridors to achieve the EU energy policy goals and economic strategies (Directorate General for Energy, 2010). However, the current situation in the North Sea region includes only radial connections to shore and offshore interconnectors with very limited steps taken towards offshore integrated grid infrastructure projects. The challenges to investing in an integrated offshore grid have been identified by many studies. As key barriers are considered:

- The divergent national regulatory regimes and the lack of a common applied energy policy or a common forward-looking investment approach among the EU member states creates uncertainty and hamper the investments in integrated offshore grid projects in the North Sea.
- The insufficient regulated return on investment, compared to the financial market conditions, leads to lack of incentives to investing in integrated grid solutions. Offshore cross-border projects are riskier and involve higher costs than domestic projects. However, TSOs receive the normal regulatory return on investment while the congestion revenues have to be passed on to the consumers or used to maintaining the current infrastructure or investing in new interconnector capacity. Additionally, the limited allowed regulatory returns have an impact on the availability of external equity; if the RoE is not sufficient the equity providers would refrain from investing. So, when regulatory regimes do not give incentives there is no direct financial incentive for TSOs or other investors to choose such a solution. European Commission addresses that under the current regulatory frameworks, not all the energy network investments, which are necessary for achieving the EU's 2020 energy policy targets, will take place or not as fast as is needed (Directorate General for Energy, 2010).
- Permitting issues pose a high risk to the completion and the costs of the projects (DG ENER, 2015) (Berger, 2011) (European Parliament, 2017). Different permitting procedures in different countries is a

¹ Northern Seas offshore grid (NSOG): “Integrated offshore electricity grid development and interconnectors in the North Sea, Irish Sea, English Channel, Baltic Sea and neighbouring waters to transport electricity from offshore RES to centres of consumption and storage and to increase cross-border electricity exchange” (European Parliament, 2017).



major barrier for delivering cross-border projects on time and obtaining financing; complex and lengthy permitting makes lenders and investors reluctant to provide the required funds or they increase the financing costs to fit the risk profile of the project (Berger, 2011). The time between the planning phase and the final commissioning of a power line, without facing any major obstacles are estimated more than 10 years (ENTSO-E, 2010). It is noted that the EC has estimated an EUR 100 billion investment gap by 2020 for energy transmission networks partially due to delays in obtaining environmental and construction permits (European Commission, 2011).

- Public opposition particularly for cross-border infrastructure projects which are often perceived as “transit lines” without local benefits (ENTSO-E, 2010). Insufficient public acceptance due to environmental concerns hinders the development of cross-border transmission investments.
- The complexity of cross-border projects and the lack of adequate compensation mechanisms: despite the proven overall benefit/positive value, a cross-border transmission project will be approved and realised only if there is a direct socio-economic benefit for the countries involved (EWEA, 2014).
- The uncertainty that comes from the non-realisation of planned OWFs can lead to higher risk of stranded grid assets. For instance, should in the future the OWFs depend greatly on the market prices for electricity and given that the TSOs are obliged to build the OWF grid connections before the Final Investment Decision (FID) of the OWFs, the risk for stranded transmission assets could be increased in case the OWFs are not going to be built.

Given the importance of developing a Northern Seas offshore grid, it is essential to remove the above barriers and to find solutions for the financing challenges in order to realise investments in an integrated offshore grid. In order to analyse the key challenges to financing the offshore electricity transmission investments and the potential instruments that can be used to support them, it is first important to understand what the investment volumes for offshore grid projects in European and national level are, what makes investors investing in these projects against other alternatives in the market, what the characteristics of the existing national regulatory frameworks for offshore investments are and what financing structures and sources are used by the grid operators and project promoters to realise the required offshore investments.

In view of the above, the present report provides an overview of the existing financing models of onshore and offshore transmission investments in the EU and examines the suitability of the current financing practices for meshed offshore grid investments.





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3 INVESTMENT VOLUMES

EU's climate and energy objectives and targets have a major impact on the electricity transmission networks. The Energy Union Package has set the targets, by 2030, of reducing the domestic greenhouse gas (GHG) emissions by 40% compared to 1990 levels, increase the RE penetration by at least 27% and reaching at least 27% energy savings (European Commission, 2017a). EC has proposed to increase the interconnection target to 15% by 2030 (European Commission, 2017b). In order to facilitate higher levels of RE into the electricity system, while contributing to the decrease of CO₂ emissions, the transmission grid has to be adapted accordingly. Significant transmission investments, related to the upgrade and extension of the grid are needed to secure the connection of the RES to the load centres. To this end, offshore electricity grid infrastructure can play a key role. Offshore wind energy is one of Europe's largest domestic energy resources and its key enabler, an offshore grid in the Northern Seas, is a critical infrastructure project for the achievement of the 2030 objectives of the Energy Union Package. This development would enable access to the large scale offshore wind, contribute to the reduction of GHGs emissions and increase energy security (Gaventa, Bergamaschi, & Ryan, 2015).

However, the balance sheet constraints of the TSOs pose critical questions; will the TSOs be able to cope with the significant amount of investment needed in the long run? Will sufficient volumes of debt and equity be available to finance the electricity transmission grid investments? Will the TSOs and projects promoters have access in the future to the necessary financing in order to be able to invest in a MOG in the North Sea region?

EC has estimated a significant volume of investment needs in the European electricity transmission by 2020 and beyond in order to meet the EU's energy targets. In this section the investment figures as well the investment gap estimated by the EC are presented in order to understand the magnitude of investment effort which is expected by the TSOs. TSOs are obliged to meet the domestic investment plans, as set by the national governments. Therefore, the North Sea investment plans, determined by ENTSO-E TYNDP 2016, as well as the national investment plans for the OWF grid connections and interconnectors are described below, in order to highlight the substantial amount of offshore grid investments that the TSOs have to cope with. Finally, an overview of the investor appetite for investments in the offshore wind transmission infrastructure is provided in order to understand the drivers which make these investments more attractive than alternative ones in the market.

3.1 INVESTMENT NEEDS IN EUROPEAN ELECTRICITY TRANSMISSION GRIDS

There are several studies which have estimated the European electricity transmission investment needs by 2020 and beyond. In these studies it is addressed that despite the regulatory measures and the policies, that are currently available to facilitate the strategic energy infrastructure investments, a significant amount of investments will not be realised within this time frame. Hereafter, the estimated investment gaps for strategic energy transmission as well as the investment needs for a Northern Seas offshore grid, as estimated by the EC, are presented.



Investment needs in European transmission grid and financing gap

In European Commission's Communication for "Energy infrastructure priorities for 2020 and beyond- A blueprint for an integrated European energy network" (COM (2010) 667 final of 17 November 2010) it is stated that the investments needed in energy transmission networks to achieve the EU's energy targets account for approximately EUR 200 billion. Of this amount, about EUR 140 billion is for high voltage electricity transmission investments, onshore and offshore, storage and smart grid applications at transmission and distribution level. The remaining and about EUR 70 billion (approximately) is for gas transmission pipelines storage, liquefied/compressed natural gas (LNG/CNG) terminals and reverse flow infrastructure (European Commission, 2014). In its Communication, EC estimates that only the 50% of the required investments for transmission networks will be reasiled by 2020 leaving a financing gap of around EUR 100 billion. According to EC, this gap is due to delays in permitting processes as well as to challenges related to the access to finance and risk mitigation measures (European Commission, 2011).

The organisation of the European transmission system operators for electricity, ENTSO-E, estimates, by 2030, EUR 150 billion electricity transmission investments of pan-European significance, of which EUR 80 billion is for projects already endorsed in national and/or intergovernmental agreements (ENTSO-E, 2016).

Investment needs in Northern Seas offshore grid and financing gap

The offshore electricity grid in the North Sea represents an investment of high importance for Europe and it has been identified as a priority area under the EU regulation No 347/2013 on guidelines for trans-European energy infrastructure. The North Sea region presents a strong project pipeline including OWF grid connections and offshore interconnectors. For this region alone, ENTSO-E estimated a total investment plan of EUR 100 billion for offshore electricity grids by 2030 (ENTSO-E, 2014). Table 1 shows the investment need by 2020 in the Northern Seas offshore grid, the expected investment gap and the public funding that is needed to support the required investments, as estimated by the EC (European Commission, 2012).

Priority Corridor	Northern Seas offshore grid (NSOG)
Description	Integrated offshore electricity grid development and interconnectors in the North Sea, Irish Sea, English Channel, Baltic Sea and neighbouring waters to transport electricity from offshore RES to centres of consumption and storage and to increase cross-border electricity exchange.
Investment need	EUR 30 billion -
Investment gap	EUR 8 billion -
Co-financing ratio need	10%
Likely need for public funding	EUR 0.80 billion

Table 1: Northern Seas offshore grid investment needs up to 2020. Source: (European Commission, 2012)

Many studies have identified the reasons behind the investment gap. EC addresses that many energy infrastructure projects which have an added value to the EU's energy objectives (e.g. security of supply) are not commercially viable mainly due to the fact that not all the investment costs can be recovered through tariffs (European Commission, 2012). Especially for cross-border interconnection projects the cost allocation mechanisms are very often not sufficient, leading to significant delays of the projects or even cancellation. Moreover, the enormous investment needs in combination with the uncertain future of the financial markets

adds to the gap; TSOs will need to build significantly more projects than in the past. For many, this will be a major challenge for their financial viability and their ability to access long term financing needed for their projects. The increasing cost of financing as a consequence of the credit crisis and the regulatory measures which follow (Basel III, Solvency II) will add to the investment challenge. (European Commission, 2012)

Annual investments in interconnectors currently represent about EUR 0.9 to 1.5 billion but in a high RES scenario are expected to rise substantially to an average of EUR 3.6 billion annually (Directorate General for Internal Policies, 2017). Table 2 presents the annual average estimates for electricity investments in interconnectors and transmission grids based on different scenarios and studies.

Grid investments	Estimates 2011-2020	Estimates 2021-2050
Interconnectors	EUR 0.9-1.5 billion annually	EUR 0.5-3.6 billion annually
Transmission	EUR 4.6-5.3 billion annually	EUR 6-12.3 billion annually
Sum	EUR 5.5-6.8 billion annually	EUR 6.5-15.9 billion annually

Table 2: Annual average estimates of electricity investment levels in interconnectors and transmission grids. Source: Figures taken from (Directorate General for Internal Policies, 2017)

3.2 NATIONAL INVESTMENT PLANS

As previously mentioned, EUR 100 billion have been estimated by ENTSO-E to be invested in the offshore electricity grid of the North Sea region by 2030. However, national governments are currently failing to realise this investment due to the lack of long term investment plans and strategies for the offshore electricity grid. Hereafter an overview of selected national investment plans for grid connections of OWFs and offshore interconnectors is presented.

Table 3 presents a summary of the national investment plans for the connection of OWFs to the onshore grid that are expected to be delivered within a certain time horizon. Only Germany has set longer term investment plans, till 2030. It is apparent that the North Sea countries apply short term energy policies and lack a common European vision for the future energy system, which puts at stake the development of a regional offshore grid.

It is noted that in Belgium the OWFs are so far connected to the onshore grid by the generator but in the future Elia, the national TSO, plans to create the Belgian Offshore Grid, where the offshore wind farms will be connected to a high-voltage substation located on an offshore platform, which will, in turn, be connected to the onshore grid (Elia, A meshed grid, 2017). In Norway, there are no OWFs at the moment and consequently no investment plans for grid connections.

Country	Time horizon	Investment Volume
Germany	2030	EUR 12 billion
Netherlands	2023	EUR 2 billion
Denmark	2020	EUR 1.2 billion
Belgium	-	0
Norway	-	0
UK	Round 4	230 million £
	Round 5	2,067 million £

Table 3: National investment plans for OWF grid connections

TSOs provide at specific time intervals the national development plans for electricity grids, which are based on their national scenarios that are not always consistent with the ones from the Community-wide TYNDP-E (ENTSO-E, 2015). TYNDP-E includes only the projects which are of pan-European significance.

In Table 4 the mid-term national investment plans (projects to be commissioned by 2022 and have received intergovernmental approval (ENTSO-E, 2015)) for offshore interconnectors in several countries surrounding the North Sea, are presented.

Country	Time horizon	Interconnector projects	Investment Volume
Germany	2016-2021	NordLink	EUR 0.75-1 billion
	2014-2018	Kriegers Flak - CGS	NA
Netherlands	2015-2019	COBRACable	EUR 0.267 billion
Denmark	2014-2018	Kriegers Flak - CGS	NA
	2015-2019	COBRACable	EUR 0.267 billion
	2014-2022	Viking Link	DKK 8 billion
Belgium	2015-2019	Nemo	EUR 0.35 million
Norway	2016-2021	NordLink	EUR 0.75-1 billion
		NSN	EUR 1 billion
UK	2014-2019	Eleclink	0.49 billion £
	2015-2019	Nemo	EUR 0.35 million
	2016-2021	NSN	EUR 1 billion
	2018-2022	Fab Link	EUR 0.75 billion
	2015-2020	IFA2	0.35 billion £
	2014-2022	Viking Link	0.85 billion £
	2016-2021	Green Link	NA

Table 4: National investment plans for offshore interconnectors

3.3 INVESTOR MODELS

Currently there are three investor models in Europe for connecting OWFs to the onshore grid; the TSO model, the OWF generator model and the OFTO model (exclusively in UK). In case of offshore interconnectors the investor can be the national TSOs of the interconnected countries or private investors. Hereafter a short

description of the type of investors for OWF grid connections and interconnectors are given. Additionally, the investor appetite and the impact of the financial markets on the investments in electricity transmission infrastructure are presented.

Investor model for OWF grid connections

The TSO model is currently dominant in several European countries including Germany, the Netherlands, Denmark and Belgium, where the responsibility for the connection of the OWF to the onshore grid falls upon the national TSOs. In the UK, offshore transmission operates under a third party model – the Offshore Transmission Owner (OFTO) regime. The OFTO transmission systems operate independently from the onshore transmission system, though they are still regulated by the same entity (Ofgem) and are paid by the NETSO (National Electricity Transmission System Operator), which in the case of England and Wales is National Grid. In the current regime (the Enduring Regime), there is the possibility to have tenders for a generator-build or an OFTO-build. The decision between these two options lies with the generator (further details provided below in section 3.4.2).

Despite the third liberalisation package for electricity, which requires the unbundling of TSOs from the OWF generators, in some countries and under certain conditions, the generator model is still used for OWF grid connections. For instance, in Denmark the generator finances the grid connection to the shore for near to shore wind farms and in Belgium the OWFs have been, until now, individually connected to the onshore grid. In Sweden the generators are responsible for the design and development of the grid connection to shore and they also finance their grid connection. However, for the connection of the OWFs to the onshore grid, most countries with offshore wind, including Germany, the Netherlands, Denmark and Belgium have extended the TSO model from onshore to offshore, with the UK's OFTO model being the exception. There are several practical reasons for this choice; the OWF grid connection can add a substantial cost to the total capital expenditure (CAPEX) of an offshore wind project (15%-30% of the CAPEX) (IRENA, 2016). Additionally, on offshore, unlike onshore, it is often the case that several generators ask to be connected in the same area at the same time. Where the TSO is responsible for the grid connection (and rather not the OWF generator), an advanced and economic connection planning can be achieved by coordinating the requests for grid connection and capturing economies of scale (Meeus, 2014) (PwC, Tractebel Engineering, ECOFYS, 2016). Given a MOG, where hybrid grid solutions (combination of OWF grid connections and cross-border interconnections) take place and thus, an even greater financing effort as well as coordination is expected, the OWF generator is not seen as the dominant model for financing a MOG.

Investor model for offshore interconnectors

Traditionally, the interconnector investment is on a fully regulated basis by a TSO in order to secure the long-term ability of the system to meet electricity demand. In Norway, in the period 2013 to 2016 it was regulated by law that only the Norwegian TSO was allowed to own and operate interconnectors. Since 1 January 2017, however, private investors are also allowed to own and operate interconnectors, following an amendment to the Energy Act (The Ministry of Petroleum and Energy, 2016).

In the European legal context, the owners of merchant interconnectors should be separated (unbundled) from the TSOs in whose system will be built (Regulation (EC) No 1228/2003, 2003). In many cases the owners of merchant interconnectors are financed by holding companies that also own TSOs. For example, BritNed is a



joint venture between National Grid International Ltd., a subsidiary of National Grid Holding and NLink International B.V., a subsidiary of TenneT Holding B.V. (see 5.3).

Since 2014, a new regulatory regime for interconnectors was developed in the UK, the "Cap and Floor" regime. The Cap and Floor results from a compromise between a more market-based (merchant) approach for interconnectors, raised by Ofgem, and the common EC policies (see 4.4.3). In Nemo interconnector project, where the Cap and Floor regime will be applied, the investors and owners are National Grid and Elia, the national TSOs of Great Britain and Belgium respectively.

Investor appetite

The investor appetite in terms of liquidity available and willingness to invest in the offshore electricity transmission infrastructure in Europe plays a key role on the financing of these investments. In 2016, TenneT Holding B.V. issued their second EUR 1 billion green bond for investments in the connection of OWFs to the onshore grid in Germany which was four times oversubscribed. This demonstrates that there is a keen market interest for offshore grid investments. However, given the enormous investment volumes that are anticipated for the development of more complex and riskier hybrid solutions, with combination of OWF grid connections and interconnectors, it is questionable whether the investor appetite will continue to be sufficient to finance these complex and riskier investments.

According to a study carried out by DG ENER (DG ENER, 2015) which is partly focused on the assessment of the investor appetite in the electricity transmission infrastructure projects, it was found that this type of assets are attractive due to the long term drivers for investments, the regulated and stable rate of return and the low risk nature of these assets. These characteristics along with the high level of capital available internationally, which searches particularly for European energy infrastructure projects, make these investments very attractive to the private investors.

There is a diversity of investors active in the offshore electricity transmission sector in Europe. Primarily, transmission system operators invest in OWF grid connection projects, since the electricity transmission grid is a regulated sector and in most wind nations the responsibility for the finance and operation of the offshore grid falls upon the national TSO.

Infrastructure funds (funded by pension funds, insurance companies and private funds) are interested in these investments, since they are regulated and thus, characterised by long-term, low risk and stable yields. They are passive investors and they prefer to form partnerships with experienced operators, such as the TSO (e.g. partnership of CIP with TenneT in DolWin3 project) (Global Capital Finance, 2014).

Institutional investors, such as pension funds and insurance companies, have expanded their investment activities in the offshore electricity transmission infrastructure. Pension funds in particular typically seek to invest a minimum of EUR 100-250 million per deal (Global Capital Finance, 2014), a transaction size which is offered by offshore transmission assets. Moreover, they prefer to co-invest alongside experienced financial partners and consequently make minority investments. Institutional investors invest equity or debt in projects although the majority prefers equity as it generates higher returns (Global Capital Finance, 2014). They benefit from the long-term predictable and stable cash flows of the offshore electricity infrastructure assets. Furthermore, other reasons which have made pension funds to consider offshore electricity transmission projects as a better investment are the cost parity with conventional power generation sources and the increasing regulatory risk of fossil fuel-based generation assets (Mittal, 2015).



Corporate investors, like Japanese investors, invest in European offshore electricity transmission assets driven by financial and strategic reasons (Global Capital Finance, 2014). The negative interest rates in Japan have pushed the largest Japanese banks to add more project finance loans for, primarily European, renewable infrastructure projects. For instance, in 2016, Sumitomo Mitsui Financial Group provided debt for the purchase, operation and maintenance of the Humber Gateway offshore transmission system in UK (offshoreWIND.biz, 2016). Additionally, Japanese trading houses like Mitsubishi Corporation, invest in European offshore electricity transmission assets in order to gain experience which will apply later to their domestic markets. Therefore, they tend to form partnerships with experienced players (TSOs) (Global Capital Finance, 2014). Table 5 presents the diversity of investors who are active in the offshore electricity transmission grids in Europe as well as the factors which make these assets attractive to the investors.

Type of investors	Examples investors	Investment focus
TSOs	TenneT owner of several offshore transmission assets in the Netherlands and Germany	Network operators are obliged by national laws to connect the OWFs to the grid.
Institutional investors	PensionDenmark owns shares in DoWin3	-They are interested in large scale long-term investments with stable rate of return, such as offshore transmission infrastructure -Transmission infrastructure is a better investment avenue compared with investments in conventional power generation sources
Infrastructure funds	Copenhagen Infrastructure Partners (CIP) Transmission Capital Partners owns the TC Barrow OFTO Limited	They focus on long-term infrastructure investments with stable cash flows and low correlation to the ordinary business cycles.
Corporate investors	Mitsubishi Corporation (BorWin1,2 HelWin2,)	-Long-term price stability positive impact on brand and PR -In case of the Japanese investors: gain experience that can be applied to developing projects in Japan's deep waters

Table 5: Investor landscape in the European offshore electricity transmission infrastructure

3.4 SUMMARY

The development of a Northern Seas offshore grid is one of the key infrastructure projects to achieve the European energy targets by 2030. ENTSO-E estimates that the investment needs for a North Sea grid is EUR 100 billion by 2030. Moreover, in its Communication, EC estimates that only the 50% of the required investments for energy (gas and electricity) transmission networks will be realised by 2020 leaving a financing gap of around EUR 100 billion. The aforementioned figures highlight the enormous investment volumes needed for the development of such a project. To this end, the national TSOs, as the regulated entities obliged to connect OWFs to the grid in most North Sea countries and invest in offshore interconnectors, will play a key role. The significant investment needs for a North Sea offshore grid in addition to the required national investment plans give an indication of the magnitude of the financing challenge the TSOs are going to face in the long run.

Apart from the TSOs, there is a diversity of investors active in the offshore electricity transmission sector in Europe. Institutional investors, infrastructure funds and corporate investors are attracted by the long term drivers for investments, the regulated and stable rate of return and the low risk nature of electricity transmission assets. Furthermore, it should be highlighted that the TSOs are global market players and they need to attract the necessary capital to invest according to the conditions of these markets. The current low interest rates and the special characteristics of the wind electricity transmission infrastructure, which has a low risk profile and provides long-term, regulated rate of returns, make these investments more attractive than alternatives in the market. However, if the financial conditions change (i.e. interest rates increase) in the future and given that the investment trend is maintained by 2030, it is questionable whether the TSOs will be able to put in practice the offshore network development plans; in such case, the TSOs' investments would be in greater competition with other more favourable investments in the market and thus, the financing potential for the TSOs would be limited.



4 REGULATORY FRAMEWORK FOR ELECTRICITY TRANSMISSION INVESTMENTS

As mentioned previously in section 3, the TSOs are called to meet a significant amount of grid investments by 2030. In order to finance the required investments, the TSOs have to raise large volumes of debt and equity. In all EU Member States the electricity TSOs are regulated and their grid investments are supervised and approved by the National Regulatory Authorities (NRAs). The regulatory framework for grid investments has a profound impact on the feasibility of the financing of the TSOs. The regulatory framework should allow a sufficient rate of return which covers the CAPEX of the investments, the payment to shareholders and debt holders, while ensuring the long term financial viability of the TSOs. Moreover, for projects which are highly desired by EC, such as OWF grid connections and interconnectors, the national electricity transmission regulatory frameworks should give appropriate incentives for prioritising these investments which exhibit higher complexity and risks compared to the average (ENTSO-E, 2014b).

Despite the fact that investments in electricity transmission are a regulated business activity, public funding is needed. Especially, for offshore interconnectors, whose profitability from economic point of view depends solely on the price difference between two markets, it should be considered to what extent the envisaged grid infrastructure in the Northern Seas can be funded on a purely market-driven basis (EWEA, 2014).

In this section, an overview of the current EU policies and funding mechanisms developed to support cross-border offshore electricity transmission investments is given. Moreover, the main principles of the regulatory frameworks for electricity transmission investments as well as the particular characteristics of the TSOs' national regulatory regimes for onshore and offshore grid investments are presented. A description of the OFTO regime for OWF grid connections as well as the 'Cap and Floor' regime for offshore interconnectors in the UK is also provided.

4.1 EU FRAMEWORK FOR INVESTMENTS

Since the economic and financial crisis the investment levels across the EU have been reduced dramatically. Specifically, the investment levels have been dropped to approximately 15% since its peak in 2007 (Official Journal of the European Union, 2015). The investment gap indicates a market failure and reluctance of private investors to take risks, mainly due to the uncertainty regarding the future of the economy and the regulatory hurdles (S&P Global ratings, 2017). The money is available but the investors have adopted a "wait and see" attitude; instead of investing they save their money until uncertainty dissipates (CEPS, 2014). This poses a threat to the EU's long-term growth, its global competitiveness and thus, its energy and climate objectives. In order to reduce the investment gap, restore the investors' confidence and strengthen its competitiveness, the EC has developed several financial strategies and instruments. Especially, in the field of cross-border energy infrastructure, a number of policy tools, funding programmes and lending schemes are provided by the EU to stimulate strategic investments which have a clear contribution to the objectives of security of supply, integrated energy markets and the reduction of CO₂ emissions. These tools are described in this section.



Projects of common interest (PCI)

The concept of PCIs was developed to aid the completion of an integrated European energy market and to meet the EU's energy policy objectives for affordable, secure and sustainable energy (European Commission, 2017a). PCIs are governed under Regulation (EU) No 347/2013 on guidelines for trans-European energy networks (TEN-E). The main benefits of the PCI label are:

- accelerated planning and permitting procedures (3.5 years for granting a permit)
- a single national authority for providing permits (“one-stop-shop”)
- streamlining of environmental assessment procedures
- increased public participation through consultations
- increased visibility to investors
- access to financial support by the Connecting Europe Facility

Funding instruments

There are several funding mechanisms developed by the EU to stimulate investments in the field of electricity transmission infrastructure. Table 6 gives an overview of the characteristics of these mechanisms, whose aim is to fill the financing gap for strategic investments in the EU by mitigating certain risks for the projects and thus, the cost of capital for investors and facilitating access to finance. The financial support from these programmes can take different forms; there are financial instruments, such as debts, equity capital and grants, or guarantees to energy infrastructure investments. Especially CEF is a programme which focuses on PCIs and thus, plays a crucial role in supporting the electricity transmission projects of supra-national interest (ENTSO-E, 2014). However, ECF covers only 2.7% of the trans-European energy infrastructure investment needs up to 2020. The average annual CEF budget available for electricity and gas PCIs amounts to approximately EUR 0.73 billion, while the average investment needs for electricity transmission and interconnectors until 2020 are estimated in a range EUR 5.5 to 6.8 billion annually as already mentioned in 3.1. Therefore, the current financial support from CEF, on its own, would not be sufficient to co-finance all eligible projects (Directorate General for Internal Policies, 2016). It is noted that the scope of these mechanisms is much broader than covering only the investment needs in electricity transmission and interconnection in the EU.

Funding programme	Applied period	Total budget available	Types of financing
European Fund for Strategic Investments (EFSI)	2015-2017/18	EUR 16 billion EU guarantee & EUR 5 billion EIB capital	Financial instruments
Connecting Europe Facility (CEF)	2014-2020	EUR 5.35 billion for energy projects	90% Grants 9% financial instruments 1% project support actions
European Energy Programme for Recovery (EEPR)	2009 - Ongoing	EUR 3.98 billion (EUR 2.3 billion for gas & electricity infrastructure)	Grants & financial instruments
European Investment Bank (EIB)	Ongoing	EUR 7.5 billion in energy (as per 2014 ²)	Financial instruments (subsidised/guaranteed loans)

Table 6: EU funding mechanisms for electricity infrastructure

² (EIB, 2015)

4.2 PRINCIPLES OF REGULATORY FRAMEWORKS

The electricity network is characterized as “natural monopoly”, which means that the competition is limited or does not exist at all. Therefore, in order to foster transparency of costs and improve efficiency of transmission, the electricity network is regulated. This legal task is fulfilled by many national regulators through “incentive regulation”. The economic principle of incentive regulation is based on the simulation of competition and on motivating a network operator to manage its operations more cost efficiently than comparable network operators in other regions or in other countries. Hereafter, the main principles and common elements of the current European regulatory frameworks for grid investments are presented.

Regulated Asset Base (RAB)

The current dominating regulatory model around the European countries is based on the Regulated Asset Base (RAB) of the transmission operators. RAB is defined as the amount of money a company has invested and they are paid a return for this investment (EY, 2013).

Allowed revenue

The incentive regulation model and revenue cap are based on the RAB structure. In these regulatory models the allowed revenue is estimated as depicted in the following simplified equation:

$$\text{Allowed revenue} = \text{Efficient OPEX} + \text{Asset remuneration} + \text{Depreciation} ,$$

Equation 1: Allowed revenue Source: (EY, 2013)

The terms used in Equation 1 are described below:

- Efficient OPEX (Operational Expenditure) are the costs of an efficient system operator, defined by the national regulator.
- The Asset remuneration is based on an assessment of the RAB, using the accounting value of fixed assets or a standard or inflation-linked value, and an applied rate of return that may be pre- or post-tax, nominal or real (EY, 2013).
- The depreciation is related to the RAB.

Weighted Average Cost of Capital (WACC)

The WACC formula is a commonly used method for determining a rate of return on an asset base (Glachant et al, 2013). It is set equal to the sum of each component of the capital structure weighted by its share as shown in Equation 2.

$$\text{WACC} = \text{CoD} \times \text{gearing} + \text{RoE} \times (1 - \text{gearing})$$

Equation 2: WACC methodology

The terms used in Equation 2 are described below:

- *CoD* is the cost of debt set by the national regulators and reflects the national financing and tax conditions.
- The *gearing* describes the relation of debt to equity in the TSOs' balance sheet and is set by the regulator typically in the range of 60%-70% (debt/ (debt+equity)) (Berger, 2011).
- *RoE* is the allowed rate of return which the national regulator allows the TSOs to earn on the equity component of their capital structure.

Return on Equity (RoE)

The allowed return on equity (RoE) set by the regulator is the clearest incentive for further investments (Berger, 2011). The RoE is set by the regulators using the Capital Asset Pricing Model (CAPM) and is determined as follows:

$$RoE = R_f + \beta \times (R_m - R_f)$$

Equation 3: CAPM method for determining the RoE

The terms included in Equation 3 are described below:

- R_f is the risk-free rate which is typically a 10-year government bond yield (DG ENER, 2015).
- R_m is the market return.
- $R_m - R_f$ represents the equity market risk premium that the equity investors demand to compensate them for the extra risk they accept (Investopedia, 2017b).
- β is the beta equity and in finance is a measure of risk. It shows how much a company's share price reacts in relation to the market; if $\beta=1$ the company moves in line with the market, if $\beta<1$ the company's shares are more stable than the market and if $\beta>1$ the share is more volatile in relation to the market. The electricity transmission grids which are regulated assets are considered less risky and thus, benefit from a relatively low beta (EY, 2013).

It is noted that the last years a decrease in RoE, set by the national regulators, has been observed. This trend is due to the lower interest rates in the countries which have not been badly affected by the financial crisis (EY, 2013). This also reflects a decrease in the risk-free rate and the intention of the regulators to keep up with the broader economic and financing conditions. The general downward trend is evident on the rates of return in Germany as presented in Table 7.

Regulatory periods	1st regulatory period (01.01.2009 - 31.12.2013)	2nd regulatory period (01.01.2014 - 31.12.2018)	3rd regulatory period (01.01.2019- 31.12.2023)
Risk-free rate	4.23%	3.80%	2.49%
Market premium	4.55%	4.55%	3.80%
β equity	0.79	0.79	0.83
Rate of return on equity before taxes (for new facilities)	9.29%	9.05%	6.91%
Rate of return on equity after taxes (for new facilities)	7.82%	7.39%	5.64%

Table 7: Decrease of the rate of return on equity in the German regulatory framework Source: (BNetzA, 2008), (BNetzA, 2011), (BNetzA, 2016)

Revenue cap and cost elements

A revenue cap is set by the regulator to limit the amount of the total revenue received by the TSO, which holds a monopoly status in the industry. Depending on its design, the revenue cap can include all the total expenditure (TOTEX) of the TSO or may include only one part of the operating costs (e.g. controllable OPEX) while the other costs are remunerated through a cost-plus or pass-through mechanism. The aim of the TOTEX approach is to give more incentives for cost reduction. However, there are cost items which are not fully under the TSO's control, such as the network losses in an interconnected transmission system, which depends on the non-

controllable cross-border flows (Glachant et al, 2013). The costs, on which the TSO has little or no control, should not be included in the revenue cap but rather be compensated through other mechanisms (cost-plus or pass-through) (Glachant et al, 2013). Furthermore, it is noted that it is difficult to correlate the CAPEX with the network performance, thus, to quantify the cost of under-investment that might be generated by the incentive regulation. Therefore, it is better to exclude the investment costs partially or completely from the incentive mechanism (Glachant et al, 2013).

Efficiency targets

Another common element of the regulatory regimes for electricity transmission investments are the efficiency targets, set each regulatory period, to guarantee a cost efficient performance from the TSOs. There are several methodologies for determining the efficiency targets with benchmarking being the most popular. Benchmarking is based usually on determining the efficiency frontier from a sample of companies with comparable characteristics (Glachant et al, 2013). Depending on the design of the incentivised revenue cap, the efficiency targets can be applied at different cost elements (e.g. in TOTEX or only OPEX).

4.3 NATIONAL REGULATORY FRAMEWORKS FOR TRANSMISSION INVESTMENTS

The regulatory framework for electricity transmission grid investments, especially the regulated remuneration, is one of the most important factors in financing grid infrastructure projects. The current regulatory frameworks are mainly focused on reflecting past costs supplemented with cost efficiency incentives. There are formal similarities but also substantive differences among the national regulatory regimes for electricity grid investments. Hereafter, an overview of the key characteristics of the current regulatory regimes for onshore investments in Germany, Denmark, Norway, UK, the Netherlands and Belgium is given.

Table 8 presents the national regulatory authorities and the legal ownership of the national TSOs. In most countries the national TSOs are state-owned, with Great Britain to have a privately owned TSO (National Grid) and Germany three privately-owned and one state-owned. It is noted that TenneT TSO NL is the state-owned TSO in the Netherlands, while TenneT TSO GmbH is the privately owned TSO in Germany.

Key elements	Germany	Denmark	Norway	Great Britain	Netherlands	Belgium
Regulatory authority	BNetzA	DEA	NVE	Ofgem	ACM	CREG
Legal ownership	- 3 privately-owned TSOs: 50Hertz, TenneT TSO GmbH, Amprion - 1 state-owned TSO: TransnetBW GmbH	State-owned enterprise: Energinet.dk	State-owned enterprise: Statnett	Privately-owned enterprise: National Grid	State-owned enterprise: TenneT TSO NL	State-owned enterprise (>45%): Elia System Operator

Table 8: Characteristics of the national TSOs

Characteristics of national regulatory regimes

Table 9 gives an overview of the key characteristics of the European regulatory frameworks for transmission grid investments. It is noted that the Danish regulatory regime differs significantly from the other national regimes for grid investments. Energinet.dk is a state-owned, not-for-profit enterprise, which is not allowed to build up equity or pay dividends to its owner, the Danish Ministry of Energy, Climate and Building (CEER, 2015). Therefore, it is allowed to include in the tariffs only the necessary costs of efficient operations plus the necessary return on the equity. Necessary costs are operating costs, depreciation, financial and administrative costs. No efficiency requirements for Energinet.dk are facilitated by regulation.

It is observed that the duration of the regulatory period varies among the different countries, while in the Norwegian regulatory regime there is no periodic review of the allowed revenue but it is estimated on a yearly basis.

The efficiency targets are determined based on different methodologies and benchmarking by the national regulators. It is important to notice that in some regulatory regimes (the Netherlands, Great Britain) the efficiency targets are applied not only to the controllable costs but in all type of costs (TOTEX). Finally, the current regulatory regimes do not offer significant incentives for innovation apart from the RIIO regime in the UK which is based on the premise that stakeholder engagement and investment in innovation should be encouraged.

Key elements	Germany	Denmark	Norway	Great Britain	The Netherlands	Belgium
Regulatory period	5 years 2014-2018	No regulatory period	No regulatory period, it rolls forward with updated parameters each year	8 years	5 years 2017-2021	4 years 2016-2019
Revenue cap	-non-controllable costs -controllable costs of the reference year (t-2) -CPI inflation correction -X general efficiency and productivity factor -Expansion factor -Quality factor	Not relevant	-base level costs: 40% actual values & 60% normative values -60% expected level of cost of energy not supplied (CENS) -system responsibility costs: 40% actual values & 60% normative	RIIO model: -Base revenue -Efficiency incentives, rewards and penalties -Uncertainty mechanisms	-efficient costs & rate of return on investments -yearly revenues based on the consumer price index CPI-X formula	-non-controllable costs (pass-through elements) -controllable costs (subject to efficiency targets) -influenceable costs (eligible for an incentive mechanism within predefined limits)

Key elements	Germany	Denmark	Norway	Great Britain	The Netherlands	Belgium
			values			
Estimation of the efficiency target	-International benchmarking Efficiency target: 0.3%/a (for TenneT TSO GmbH) -Productivity factor: 1.50%/a	Not relevant	NVE applies a DEA result of 100% which means that the cost norm equals the cost base for the transmission grid	TOTEX + Outputs defined by TOs and accepted by the regulatory entity (Ofgem)	-International benchmarking -Productivity analysis -efficiency target 0.42%/a -productivity factor 0.8%/a year	NA
Application of the efficiency target	-Controllable costs (CAPEX+OP EX) -cost base: t-2 -X General('catch up'+ 'frontier shift') -Efficiency factor 97% (for TenneT TSO GmbH)	Not relevant	-100% cost recovery -cost base: t-2	TOTEX + adjustment mechanisms for costs and revenues allowances	-TOTEX approach (also incentives on costs for ancillary services) -cost base: t-2 capex and t-2/t-4 opex -efficiency score 97.9%	Controllable costs & Influenceable costs
Innovation incentives	No lump-sum recognition, except for officially approved R & D projects. Indirect promotion of innovation as part of the costs for approved investment measures.	Not relevant	R&D (max 0.3% of the capital assets) can be approved as pass-through item.	Innovation stimulus package: - rewards for successful innovations - no penalties for unsuccessful innovations -partial financing for innovations	No	R&D 50% of subsidies is attributable to the net profit with a minimum of EUR 0 and maximum EUR 1 million

Table 9: Characteristic elements of national regulatory regimes

Capital remuneration

Table 10 presents the components of WACC for each country under investigation. There are some differences among the national regulatory approaches. The variation of the beta equity values show that the regulators have different perceptions about the relative risk profile of the regulated companies in their local environment. The gearing is around 60% in most countries, with the Netherlands the only exemption, with 50% gearing set by ACM.

Key elements	Germany	Denmark	Norway	Great Britain	The Netherlands	Belgium
Risk free rate	3.80%	Not relevant	2.50%	2.00%	1.28%	Interest rate for Belgian 10-year linear bonds for the year in question
Market risk premium	4.55%	Not relevant	5%	5.25%	5.05%	3.50%
β_equity	0.79	Not relevant	0.875	0.95 (for National Grid)	0.74	Based on a historical 3-year period minimum value 0.53
Gearing	60%	Not relevant	60%	60%	50%	67%
Return on Equity (RoE) pre-tax	9.05% for new assets	Not relevant	11.89% (nominal, for 2016)	7% real	5.02%	NA
Cost of Debt (CoD)	NA	Not relevant	2.10% Nominal, pre-tax(2016)	Pre-tax real: 2.55% (2015/16) 2.38% (2016/17)	2.19%	NA
WACC	NA	Not relevant	WACC pre-tax for 2016: 6.25%	4.55%	Real WACC pre tax: 3.0%	NA

Table 10: WACC components in the national regulatory regimes for transmission grid investments

4.4 NATIONAL REGULATORY FRAMEWORKS FOR OFFSHORE TRANSMISSION INVESTMENTS

A Northern Seas offshore grid is an investment which requires massive debt and equity raising (Berger, 2011). Therefore, it is also required that the TSOs receive a sufficient rate of return that covers the CAPEX of the investments, the payment to shareholders and debt holders. To this end, the regulatory framework for transmission investments should allow enough revenue and ensure the long term financial viability of the TSOs. Moreover, for projects which are highly desired by EC, such as OWF grid connections and interconnectors, the national electricity transmission regulatory frameworks should give appropriate incentives for prioritising these investments which exhibit higher complexity and risks compared to the average (ENTSO-E, 2014).

Hereafter, a description of the current national TSO regulatory regimes for offshore grid investments is given. The OFTO regime, for investments in OWF grid connections as well as the Cap and Floor regime for offshore interconnectors, both developed in the UK, are also presented.

4.4.1 TSO REGIME

The regulatory issues are considered by the TSOs and many investors as the main barrier to investing; especially the insufficient regulated return on equity, the duration of the regulatory period and the lack of incentives for specific projects (DG ENER, 2015) (Berger, 2011) (European Parliament, 2017). Especially, when it comes to the offshore grid investments, which require a significant financing effort the following questions arise: is the current regulatory framework sufficient to facilitate the significant investment volume of the offshore grid projects in the long run? Do the existing regulatory regimes provide the necessary incentives to fostering investments? In order to answer these questions, it is important first to investigate what the current regulatory frameworks for offshore grid investments are. In this section the characteristics of the national regulatory frameworks for investments related to the connection of OWFs to the onshore grid and the regulated offshore interconnectors are described. The countries which have been investigated are the Netherlands, Germany, Denmark and Belgium and Norway. In Norway, there are no OWFs and thus, no regulatory regime for offshore grid connection investments is in place.

Table 11 presents the characteristics of national TSO regulatory frameworks for investments in OWF grid connections and regulated offshore interconnectors. Denmark's regulatory regime for onshore investments applies also to offshore grid investments without any adjustment. In Belgium the OWF generator model has been applied so far for the connection of OWFs to the shore and therefore, there is no relevant TSO regulatory regime for these investments. However, interconnectors are treated as strategic investment projects and as such a mark-up is introduced for selected projects (Elia, 2016). In Germany and the Netherlands the regulatory frameworks include adjustments when it comes to offshore transmission investments. In both countries the costs of these investments are covered already during the regulatory period (construction and commissioning phase, t-0) and there is no uplift in the rate of return (RoE) (which is the same for the onshore and offshore grid investments). In Germany the OPEX included in the investment measures amount to 3.4% of the acquisition and production costs, while in the Netherlands amount to 1% of the investment value. Finally, in Norway the regulatory framework for offshore interconnectors are the same as for Statnett's onshore investments.

It is noted that none of the investigated countries have separate regulatory frameworks for offshore electricity transmission investments. The national regulators either offer the same return for all types of investment or a premium on certain types. In conclusion, the offshore investments are treated as special cases/exemptions among the overall portfolio of the TSOs' regulated investments and as such specific adjustments of the existing remuneration mechanism are applied.

Key elements	Germany	Denmark	Norway	Netherlands	Belgium
Regulatory period	5 years: 2014-2018	Not relevant	Not relevant	5 years: 2017-2021	4 years: 2016-2019
Revenue cap	For OWF connections and interconnectors: -permanently non-influenceable costs without delay (CAPEX & OPEX costs for OWF connections)	Not relevant	The same as onshore	The same as onshore: -efficient costs & rate of return on investments -yearly revenues based on the consumer price index CPI-X formula	The same as onshore plus a mark-up for strategic investment projects (interconnectors)
Adjustment mechanisms	-Revenue adjustments already during the regulatory period (t-0) for CAPEX & OPEX -OPEX amount to a lump sum of 3.4% of the acquisition & production costs covered by the offshore investment measures -pass through costs (CAPEX+OPEX)	All the necessary costs incidental to Energinet.dk's activities are covered by the tariffs. There is no special treatment for offshore investments.	No adjustments	Offshore grid investments are considered investments of national interest. t-0 remuneration is applicable. -CAPEX remuneration during construction phase -OPEX remuneration directly after commissioning. For OPEX, an estimation of 1% over the efficient investment value is used.	A mark-up for strategic investment projects

Table 11: National TSO regulatory frameworks for offshore electricity transmission investments

4.4.2 OFTO REGIME

The OFTO model, unlike TSO model, has its unique regulatory framework for investments in OWF grid connections. The key driver for the current framework is to lower the costs incurred by the consumer and not in fostering innovation. The model contains penalties/awards for poor/outstanding operational performance.

Regulatory regime

According to the current OFTO regime, the OWF generators have the flexibility to choose whether they, or an OFTO, design and construct transmission assets ('OFTO build' versus 'Generator build'). Whichever option is chosen, the assets are always transferred to (or remain with) the OFTO during the time of its operation. This was applied to Round 3 and subsequent tenders. So far all the projects have used the 'generator-build' option, which is perceived by generators as the one with the lowest risk to their own operations.



Financial model

The OFTOs are provided with a fixed 20-year revenue stream (subject to performance delivery and other adjustments) in return for operating, maintaining and decommissioning the transmission assets. The revenue stream is unrelated to the performance of the generating assets. In this sense the generator is responsible for generation of electricity and the OFTO for its transmission to shore. The payment of this revenue is made by the NETSO and stream is funded through the provision of transmission charges that the wind farm and the supplier have to pay to the NETSO (which, for the UK is the National Grid Electricity Transmission) – see Figure 1 below.

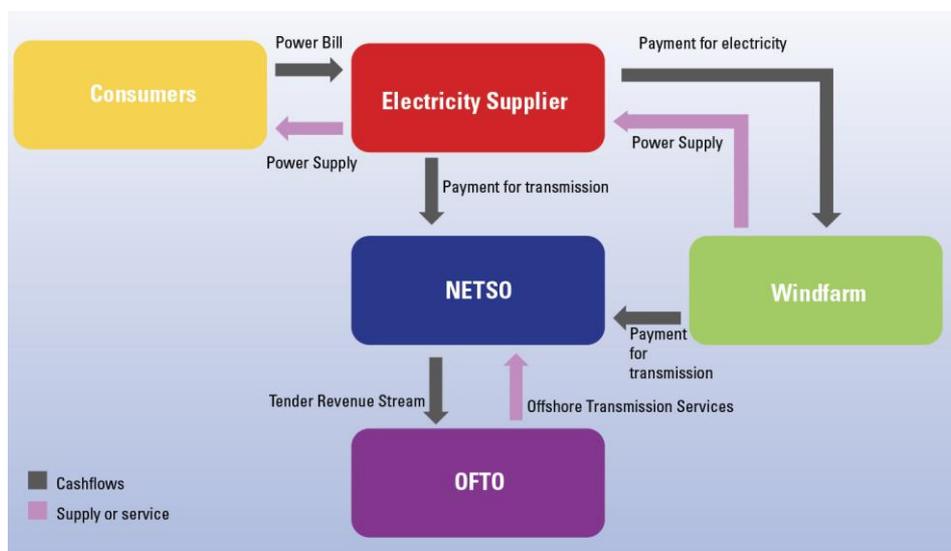


Figure 1. Illustration of cashflows and services supply (Source: KPMG report (KPMG, 2014))

Annual revenue stream

The payment of OFTOs takes place annually across a 20-year fixed period from the time the license is granted. An OFTO’s annual revenue is based on the Tender Revenue Stream (TRS) but is subject to various adjustments moderated by Ofgem during the tendering process (KPMG, 2014) (Ofgem, 2016). The exact calculation of each year’s revenue starts with the TRS and includes adjustments in relation to various factors such as market rate revenue, inflation, pass through items and performance.

Cost of capital

With projects the size of OFTO investments, an important proportion of the costs come from financing the project itself. In the calculation of the Transfer Value that is agreed with Ofgem, the financing costs incurred by the generators are included as the Interest During Construction (IDC). Within the cost reports published by Ofgem when the licenses are attributed to each OFTO, the IDC is one of the categories discriminated and its contribution to the Final Transfer Value can range from 8%-15%. Ofgem calculates the IDC rate each year in accordance to certain parameters linked with risk and the cost of capital; this rate acts as a cap rather than a fixed rate. The IDC rate is fixed for each project at the Final Investment Decision (FID) up to the end of the eligible construction period (Ofgem, 2013). The figures presented in Table 12 present estimates of the WACC (or IDC) components by using the CAPM (Beel, 2016). In these figures, IDC presents a decreasing trend, in line with the values presented in recent Cost reports (Ofgem, 2015).

Parameter	2016-17	2017-18 (expected)
Cost of debt (nominal and pre-tax)	4.29%	3.86%
Risk-free rate (nominal)	3.41%	3.12%
Market free premium	4.50%	4.40%
β ratio	0.92	0.93
Cost of equity (nominal and post-tax) ³	7.55%	7.22%
Gearing	38.70%	41.22%
Tax Rate	20.00%	19.00%
IDC or Pre-tax WACC (nominal) ⁴	7.44%	6.83%

Table 12: Indicative values for input parameters of IDC rates Source: Ofgem document (Beel, 2016)

4.4.3 CAP AND FLOOR REGIME

In the UK, the national regulator imposes limitations on the TSO, National Grid, to recover interconnector costs from customer tariffs, which makes the regulated approach (in which the investment and operation is carried out by the TSO) an impossible option. Because of this, merchant interconnectors were initially the only feasible option as a financing model (Cigre, 2017) (Stennett, 2013). However, the perceived risk by the interconnector developers was too large to generate the level of investment the regulator perceived to be of the best interest to the UK consumers. This was the case even with the application of the exemption from the regulation. In 2014, a new regime was created to regulate electricity interconnectors; this regime is called the “Cap and Floor regime”. By ensuring a minimum level of revenue to developers (floor), the Cap and Floor regime, greatly reduces the risk for investors making it a more attractive option. The main characteristics of this regime are summarised on Table 13 and described in detail the following paragraphs.

Characteristics	Description
Expected rates of return	Interest During Construction (IDC) defined in line with the OFTO regime. Differences: IDC based on the Vanilla post-tax WACC & it includes additional risk premiums. Current IDC rate of 5.10%
Regime period	25 years with 5-years evaluations cycles of the cap and floor levels applied.
Efficiency targets	Floor level only available if 80% of availability is reached. +/-2% of the cap depending on availability targets/incentives

Table 13: Main characteristics of the Cap and Floor regime for offshore interconnectors in the UK

Definition of the “cap” and “floor”

The most important characteristic of the Cap and Floor regime is the limitation of the risk both for consumers and for developers. By introducing a “cap” and a “floor” to the revenue earned by interconnectors, developers limit the risk of revenues not covering their existing costs and the system benefits from limiting the maximum profit they can earn. The definition of both the cap and floor levels is built over similar parameters used for the regulations applied to transmission operators: capital costs, operational and maintenance costs,

³ These values have been calculated.

⁴ These values have been calculated.

decommissioning costs, tax and a parcel for allowed levels of return. Figure 2 illustrates the Cap and Floor regime principles.

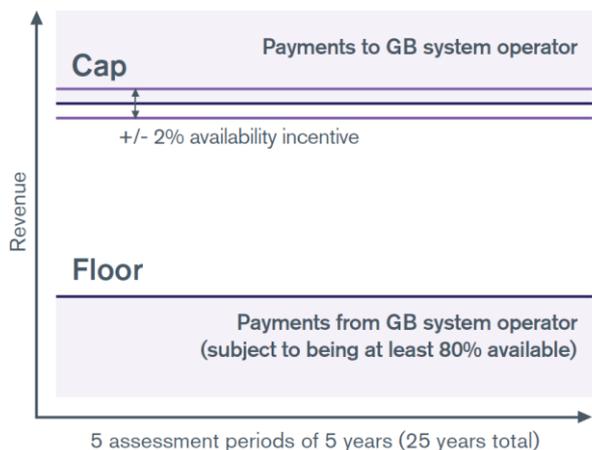


Figure 2: Scheme of the Cap and Floor regime principles Source: (Ofgem, 2016a)

The floor is defined as the minimum revenue earned by the interconnector, which is set up at a level that guarantees that the operating and that debt commitments are covered. In case the interconnector annual revenues fall short of this value, the system operator (National Grid) provides the remaining value so that the floor level is reached. This expense by the system operator is then transferred to the users of the electrical system through an adjustment of the transmission charges.

The cap is defined as the maximum revenue the interconnector is allowed to make, which includes a certain return on the investment for the developers. When the annual revenue exceeds this amount, the surplus is transferred to National Grid. This would lead to a reduction of the transmission charges paid by consumers.

Efficiency targets

To ensure that the interconnector provides a service at a satisfactory level, the validity of the floor level is only applicable if the availability rate is, at least, 80%. If the performance falls below this value, the floor payment does not apply, as depicted in Figure 2. There are also performance incentives that can move the cap level by +/- 2%, depending on the levels of availability shown (Figure 2).

Regime period

The duration of the Cap and Floor regime is of 25 years with 5-year review periods where the set cap and floor levels are reviewed. This is in line with the duration of the exemption of regulation granted by Ofgem, the UK regulator, which also runs for 25 years. If interconnectors wish to do so, they can request an interim review or adjustment for financing reasons or as anticipation to a large adjustment that will need to take place at a 5-year review.

Expected rates of return

For regulatory purposes, the cost of capital for developers is represented as the IDC. The framework for its application and calculation is similar to the one previously described for OFTOs. However, while the IDC for OFTOs was used to calculate the Tender Revenue Stream, for interconnectors it is used to define the floor and cap levels. Differences also exist in the specific rate used to calculate the IDC. In the case of OFTOs investments, IDC is set in pre-tax, nominal terms (pre-tax nominal WACC) and under the Cap and Floor regime,

IDC is set in vanilla, real term (vanilla real WACC). In addition, there are specific risk premia which are linked with the development and the construction risks. A summary of the most relevant rates is presented in Table 14.

Parameter	2017-18
Pre-tax nominal cost of debt	3.86%
Nominal risk-free rate	3.12%
Market risk premium	4.40%
Equity beta	0.93
OFTO's IDC	6.83%
Nominal, vanilla WACC	6.53%
Real, vanilla WACC	3.65%
Interconnectors' IDC	5.10%

Table 14: Input parameters of IDC rate Source: (Ofgem, 2016a)

Ofgem has recently proposed to make the update of the IDC rate an annual process, in line with what currently happens in the OFTOs' regulatory system. The main reason for this would be to increase flexibility and improve the speed of response to any market movements (Ofgem, 2016e).

4.5 SUMMARY

The regulatory framework is very important to facilitate investments in the offshore electricity transmission grids. As shown in this section, in most cases, the existing regulatory frameworks for onshore grid investments apply also to the offshore investments, the same or with some adjustments. The offshore grid investments are treated as exemptions of the existing regulatory framework for onshore investments with the costs for these investments to be covered during the regulatory period. The majority of national regulators offer the same rate of return for all types of investments without distinguishing between onshore and offshore electricity transmission investments. It is noted that a decrease of the allowed return on equity, as a consequence of the low interest rates, is observed currently in the countries that have not been too badly affected by the European debt crisis (EY,2013). However, if the investment environment changes, i.e. increase of the global and European interest rates, and given that the rate of return is fixed, in certain regulatory regimes, for a specific period of time (i.e fixed regulatory period), will the current national regulatory frameworks be still sufficient to facilitate key investments in cross-border offshore transmission projects? Will the TSOs be able in the long run to carry out the enormous investment volumes required for a MOG? The TSOs are regulated entities which need to acquire the necessary capital according to the rules and conditions of the market in order to invest. A decrease of the regulated return on equity might mean a reduction of the equity available in the future. Therefore, it is important to ensure that the regulatory framework allows TSOs to attract capital from the market at a fair rate and provide incentives for investments, enabling TSOs to overcome the financial challenge.

The UK is the only country which has developed unique regulatory frameworks for offshore grid investments. The OFTO regulatory regime for OWF grid connections, unlike the TSO regime, has a fixed 20-year revenue stream and no periodic reset of the price control. This means that there is no risk for the revenue coming from changes in the regulatory regime. The risks are only due to asset failures or cost volatility.

In the case of offshore interconnectors, the regulated model in the UK has failed since the national regulator imposes limitations on National Grid to recover interconnector costs from customer tariffs. As a result the merchant investment model was seen formerly as the most viable solution, where the merchant interconnectors have to cover their costs primarily from selling interconnector capacity. However, the perceived risk by the interconnector developers was too large to generate the level of investment the regulator perceived to be of the best interest to the UK consumers. By introducing the Cap and Floor regime, a minimum level of revenue to developers (floor) is ensured and reduces greatly the risk for investors. The Cap and Floor regime also comes to answer the concerns of investors that the creation of additional interconnectors will lead to a convergence of the prices at the different markets and hence, to a sharp decrease in revenues. However, it is questionable whether the “floor” level would be sufficient to compensate the investors/project promoters in the future under conditions of markets’ prices convergence.

Furthermore, due to the enormous investment volume required, the public funding support for key cross-border electricity transmission projects is necessary. Especially, for offshore interconnector projects, whose profitability from socio-economic point of view depends solely on the price difference between two markets, it should be considered to what extent the envisaged grid infrastructure in the Northern Seas can be funded on a purely market-driven basis (EWEA, 2014). The EU has developed a number of policies and funding mechanisms, such as the PCIs and CEF, to support and stimulate investments in offshore interconnectors. However, CEF’s annual budget for PCIs covers only 10%-13% of the annual average investment needs for transmission and interconnection. This raises doubts whether the current EU financial instruments would be sufficient to support investments in a North Sea MOG when the market alone cannot deliver them. Furthermore, if the interest rates increase, it is questionable whether the current EU funding mechanisms would be able to mobilize and attract the required private capital for investments in a MOG.



5 FINANCIAL STRATEGIES FOR OFFSHORE GRID INVESTMENTS

Given the significant investment volumes estimated for the development of a North Sea grid by 2030 as well as the national network development plans, it should be investigated whether the European offshore grid operators and owners (TSOs and OFTOs) within their current financing structures and their financial sources will be able to realise the needed investments. Therefore, it is important to understand how the TSOs and OFTOs perform their financing operations, what the financial sources they use are and how factors like ownership and leverage influence their ability to attract private capital. Especially, in the case of the TSOs, which are regulated entities, obliged in most countries to connect the OWFs to the grid and invest in offshore interconnector projects, it is also essential to investigate the drivers which affect their balance sheet and force them to adapt their financing strategies in order to be able to realise the required investments. To this end, the example of TenneT, the TSO with the largest offshore connection facilities in the Netherlands and Germany, can serve as an interesting example where balance sheet financing, under different business models, is used to finance the OWF grid connections in Germany. Furthermore, the case of OFTOs in UK is another interesting example where project finance is used for OWF grid connections. Emphasis is given also on the financing of offshore interconnectors, both regulated and merchant, as well as the different financial sources existing in the market and the public mechanisms which are available for cross-border investments. To this end, the examples of COBRACable and BritNed are examined.

5.1 FINANCING OF ELECTRICITY TRANSMISSION NETWORKS

In this section, the existing balance sheet and project finance as well as the financing sources, used by the TSOs and OFTOs to finance the offshore grid projects and interconnectors, are presented. An overview of the factors which influence the TSOs' investment and financing capabilities such as the legal ownership, gearing and credit rating is given.

5.1.1 FINANCING STRUCTURES

There are two types of financing structures for energy infrastructure projects; the corporate finance and the project finance (Berger, 2011). The corporate finance is the prevailing approach used by TSOs to finance electricity infrastructure projects. In this case, the projects are handled as part of the TSO asset base, the TSO debts are covered by its overall balance-sheet and loan repayment is guaranteed through the revenue which is created by a broader set of projects. Additionally, large volumes of funds can be acquired under better financing conditions, since the risk involved, is spread by TSO's entire portfolio of investments.

Project finance, on the other hand, is a financial structure that involves the establishment of a separate legal and economic venture in order to finance, develop and operate an infrastructure project (DG ENER, 2015). Project finance is more complex, as in this case separate processes for acquiring and managing funds on a specific-project basis are required. This implies that the project finance approach might be more expensive than



the corporate finance, since the lenders and equity providers face a higher risk when financing a stand-alone project than when financing the portfolio of TSO's projects (DG ENER, 2015). Moreover, in project finance the debt is covered only by the revenues that the project generates and not by the company's balance sheet. Table 15 below summarises the difference between the two approaches.

Financing structure	Corporate Finance	Project Finance
Characteristics	Financing on a portfolio basis and not on a specific project level Projects part of TSO asset base	Financing on a project-specific level
Debt coverage	Debt is covered by TSO balance sheet.	The debt is covered by the revenues of the project.
Financing costs and risks	Good company-specific financing conditions provided by the lenders Risk is spread through the overall portfolio of investments	Higher financing costs Higher risk for investors/lenders related to individual projects Lower risk for the TSO
Application	Domestic projects and many interconnectors are corporate-financed	Merchant interconnectors Specific regulated interconnectors as a joint venture by related TSOs

Table 15: Differences between the corporate finance and project finance approaches Source: (Berger, 2011)

5.1.2 FINANCIAL SOURCES

There are mainly three approaches which TSOs follow in order to finance their grid infrastructure investments; loans from commercial banks or institutions, funding from internal equity or funding from external investors. Table 16 presents the main sources of financing offshore electricity transmission investments.

Taking loans from International Financial Institutions (IFIs) is the most common approach the European TSOs follow to raise funding for their grid infrastructure projects. Especially EIB loans with long maturities (up to 15 years) and low interest rates covering up to 50% of the cost of a specific project (EIB, 2017d) have become a very popular financial source for TSOs and private investors. Loans from commercial banks are a conventional instrument of financing but less attractive, since they have higher interest rates and shorter maturities (5 to 10 years) (Berger, 2011). Furthermore, large TSOs such as TenneT and Elia, use corporate bonds to finance their activities. It is noted that TenneT TSO in May 2015 issued a new form of corporate fundraising, the Green Bonds. The aim of the green bond issuance is to finance projects with an environmental added value. Apart from debt, TSOs use also the cash flows of their own operations to finance their activities. However, when the debt needs to be kept under a certain level and additional capital is needed, raising external equity is the preferable solution. Finally, grants from the EU, which constitute non-reimbursable investments, is an alternative source of funding provided to the TSOs and project promoters to support the development of projects, which, due to financing challenges, e.g. financial crisis, could not be realised.

Financial sources	Description
Loans from IFIs	EIB: loans with low interest rates & long maturities can cover up to 50% of the investment cost equity financing, guarantees & project bonds Other IFIs: EBRD, World Bank, KfW
Commercial bank loans	Higher interest rates than IFIs and shorter maturities
Corporate Bonds	Debt securities with long maturities and low interest rates Green bonds to finance projects with environmental added value
Internal equity	TSOs use the cash flows of their own operations to finance their activities.
External equity	From pension funds, infrastructure funds of investment banks and insurance companies interested in investing on projects/activities with low risk profile and stable return on equity
EU grants	Non-reimbursable investments from the EU budget provided by EEPR & CEF

Table 16: Financial sources used for offshore electricity transmission investments

The current low interest rate environment and the sufficient banking liquidity make debt financing the most favourable way for the TSOs to fund offshore grid connection projects. This statement is projected in Figure 3 which comes from WindEurope's report on offshore wind statistics 2016 (WindEurope, 2017). Figure 3 presents investments in transmission assets in Germany, the Netherlands and UK from 2011 till 2016. The total investment requirement represents the total cost of the investment and the transaction value represents the commercial debt and public funds which were raised for the investments. The difference between the total investment requirement and the transaction value is the equity used for the investments (information provided by WindEurope via call). According to (WindEurope, 2017), the investments in transmission assets in 2016 account for EUR 2 billion including refinancing. From this amount, EUR 1.8 billion was raised through commercial debt, out of which EUR 1.5 billion was raised through green bond issuance from TenneT to finance the OWF grid connections in Germany (see 5.2). This means that only EUR 200 million of equity was raised to finance the offshore transmission investments in 2016. This shows that debt instruments have taken the lion's share of all instruments, since the interest rates are at their historically lowest level, as well-stated in (DG ENER, 2015) and therefore, the TSOs can raise low cost of capital (mainly debt) to fund their offshore grid investments. However, it should be pointed out that in case the current situation changes, this will affect the capital structure of the TSOs.

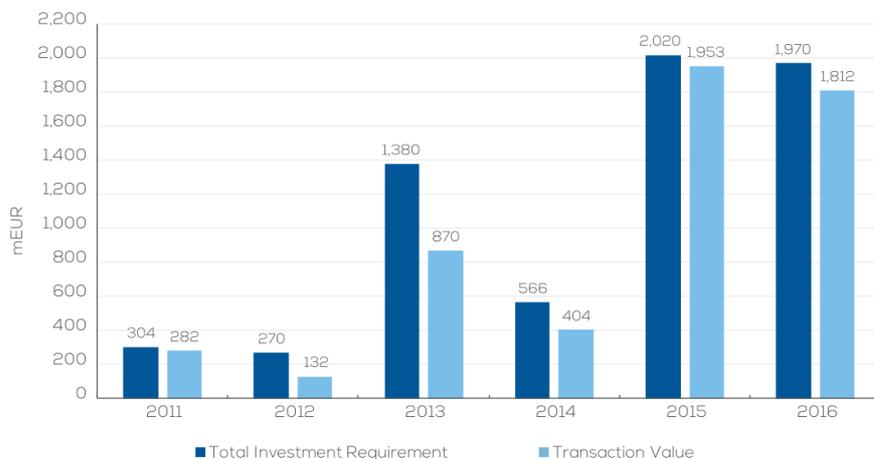


Figure 3: Investments in transmission assets in the period 2011-2016 Source: WindEurope

5.1.3 FACTORS IMPACTING FINANCING

Most TSOs in the North Sea countries use balance sheet financing also for the offshore grid investments, meaning that they finance the offshore projects as part of their overall business portfolio. The ownership, the relation of debt to equity (leverage/gearing) on their balance sheet and the credit ratings are some of the factors which highly affect the financial strategies of the TSOs and mainly their ability to raise debt and equity to meet the investment needs. Hereafter, the impact of the ownership, the leverage and the credit ratings of the TSOs on the financing are described.

Ownership

The national TSOs are privately or state owned. This has a major impact on the financing framework and financing conditions which are available for the TSOs. State owned TSOs are often not flexible in raising additional equity. This is due to the fact that the government, who is the shareholder in this case, is reluctant to increase the capital of their company due to their own budget constraints (DG ENER, 2015). Another reason is that the government might be reluctant to dilute their ownership share of essential public goods like the electricity transmission network (Henriot, 2013). On the other hand, state-owned TSOs can easier raise loans under sovereign guarantees. The increasing debt financing however, leads to a high leverage which in turn results in a lower credit rating and consequently higher funding costs. Privately owned TSOs are more flexible in raising additional private equity, when needed, but they may not raise debt under the same conditions (higher interest rates) compared to a state owned TSO which is able to secure sovereign guarantees. TenneT, the TSO with the largest onshore and offshore connection facilities in the Netherlands and Germany, serves as a good example where it can be seen that the ownership affects the TSO financing conditions and their ability to access external equity; TenneT TSO NL is fully owned by the Dutch State and cannot attract private equity for investments in the Netherlands. TenneT TSO GmbH, on the other hand, the German privately owned TSO, can attract private equity for funding the offshore grid connection projects.

Financial Leverage

According to (Investopedia, 2017), financial leverage is the degree to which a company uses fixed-income securities such as debt and equity, in order to increase the potential return on investment. A firm which uses significantly higher debt financing than equity is considered to be high leveraged. The term *gearing* refers to the

financial leverage. At a fundamental level, gearing is sometimes differentiated from leverage. Leverage refers to the amount of debt incurred for the purpose of investing and obtaining a higher return, while gearing is a type of leverage analysis which refers to debt along with total equity expressed as a ratio. According to (BusinessDictionary, 2017), the financial leverage is measured as the ratio of total debt to total assets. The leverage/gearing of TSOs reflects the relation of debt to equity on their balance sheet. The gearing of the TSO is set by the national regulatory authority, typically in the range of 60%-70%, and is influenced by the TSO's commitment to keep a certain credit rating and thus certain leverage (Berger, 2011).

Credit ratings

TSO's credit rating indicates its ability to meet its financial commitments and thus, expresses its creditworthiness. Given the significant investment volumes that are required to meet the EU energy objectives, it is important that the TSOs have access to debt and equity under market conditions (Berger, 2011). High credit ratings can ensure this. Furthermore, high credit ratings are precondition for the TSOs for issuing corporate bonds.

5.2 OWF GRID CONNECTIONS – EXAMPLES

In this section the practical examples of TenneT for the connection of OWFs to the German grid as well as the OFTO as an alternative example for financing investments in OWF grid connections are analysed.

TenneT example

TenneT is the TSO with the largest offshore connection facilities in the Netherlands and Germany and their structure and business strategies to finance the OWF grid connection investments serve as an interesting example of lessons learnt. TenneT Holding. B.V. is the parent company, while TenneT TSO NL and TenneT TSO GmbH are its subsidiary companies in the Netherlands and Germany respectively. TenneT TSO NL is appointed as the offshore grid operator in the Netherlands and is obliged to connect OWFs to the onshore grid. According to the law, TenneT TSO NL must be directly or indirectly owned by the Dutch state. Therefore, they cannot attract private equity by selling (part of) their shares. Such legal requirement, related to the 100% state-ownership, is not applicable for TenneT TSO GmbH, the German TSO, within the TenneT group. TenneT TSO GmbH is responsible for the connection of OWFs, which are located in the German part of the North Sea, to the grid.

When the Dutch TSO TenneT purchased the German TSO transpower from E.ON in 2010, inherited also an extensive pipeline of offshore wind transmission projects which accounted for EUR 5 billion (for the period 2005-2014 according to (DG ENER, 2015)). The German Government, in response to the nuclear disaster in Japan in 2011, decided to move away from the nuclear power by 2022 and to increase the support for the development of renewable energy. Due to the German energy transition, the OWFs in Germany have been built in a fast pace, more quickly than original planned. The fast pace of offshore wind development in the country raised financial and technical challenges. TenneT had to build offshore grid connections of high capacity very quickly. Back then, there was limited offshore experience among the parties involved (TenneT and suppliers) and the offshore field was a new business territory. Furthermore, the tight state financing and the legal requirement of 100% state-ownership, which prevents stake sales of TenneT, posed a challenge to raising equity for financing



the German offshore grid connections. At the same time, the company would not increase its debt for fear of harming its A- grade investment rating.

In order for TenneT to finance the offshore grid expansion in Germany, while keeping the financial ratios at a level that conciliates with the required A-/A3 rating levels, TenneT had to raise new equity in Germany through an innovative equity structure; separate project companies, special purpose vehicles (SPV), were incorporated to sell minority voting interest (voting rights) of the offshore connection projects to private parties. In order to balance risk and reward in these projects, separate “mini TSOs” were incorporated in order to have a separate revenue cap for each specific project.

In parallel, TenneT Holding B.V. raises, only at holding level, new debt financing. TenneT has several sources of debt funding, such as public (green) bonds, financing by the European Investment Bank (EIB), the German Schuldschein and recently the hybrid green bond. All this debt financing is raised at TenneT Holding level in order to benefit from its A-/A3 rating and to avoid any subordination. The proceeds from this external debt are injected either as a loan or as equity into the offshore projects. This financing structure is illustrated in Figure 4.

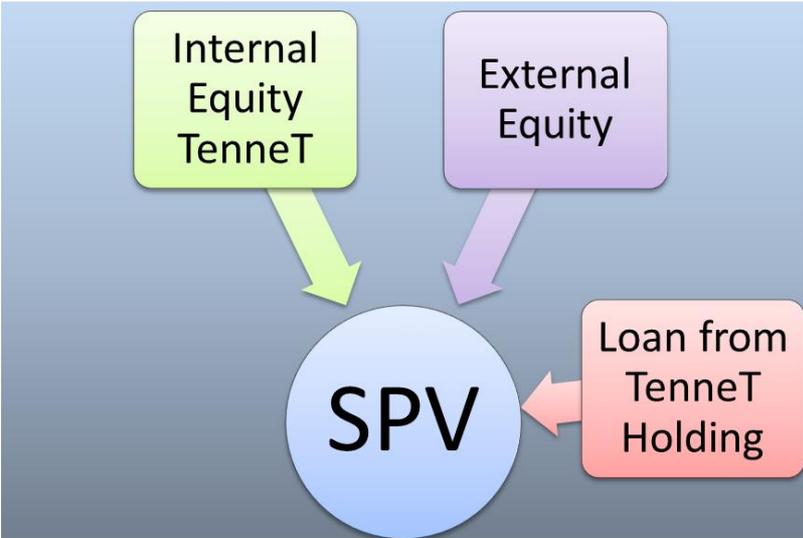


Figure 4: Financing structure of SPV for the German OWF grid connection projects

Table 17 gives an overview of the characteristics (year of issuance, size, tranches, coupons and maturities) of the green financing instruments used by TenneT to finance their green project portfolio.

No.	Year of issuance	Size	Tranches	Coupons	Maturities
1	2015	EUR 1 billion	2 x EUR 500 million	0.875% & 1.750%	6 & 12 years
2	2016	EUR 1 billion	2 x EUR 500 million	1% & 1.875%	10 & 20 years
3	2016	EUR 500 million	-	1.25%	17 years
4	2016	EUR 500 million green Schuldschein	1 x EUR 77 million	0.646%	6 years
			1 x EUR 100 million	0.989%	8 years
			1 x EUR 55 million	1.310%	10 years
			1 x EUR 50 million	1.500%	12 years
			1 x EUR 138 million	1.750%	15 years
5	2017	EUR 1 billion green hybrid bond	-	2.995%	7 years

Table 17: Green bonds, green Schuldschein and green hybrid bond issued by TenneT Holding B.V. Source: figures from TenneT's website

OFTO example

OFTOs, unlike TSOs, are exclusively privately owned by entities created for the project's tender process and operate independently from the onshore transmission system, though they are still regulated by the same entity (Ofgem) and are paid by National Grid. The entities which own the OFTOs are linked to consortia constituted by companies that are either specialised/infrastructure managing or investment companies.

In the case of OFTO, both on balance sheet financing and project financing are possible. So far, only project financing has been used, which is done through SPVs (KPMG, 2014). Unlike the TSOs which are state owned and therefore, not able to attract external equity, OFTOs have not such constraints. However, to date, OFTO projects have generally adopted highly leveraged project finance with the gearing ratios falling between 81% and 91%. These gearing ratios are high compared with the range of gearing ratios of offshore wind projects Europe-wide (between 60% and 70%) (European Wind Energy Association, 2013), based mostly on long term loans (DG ENER, 2015). Figure 5 illustrates the financing structure of a high leveraged OFTO SPV.

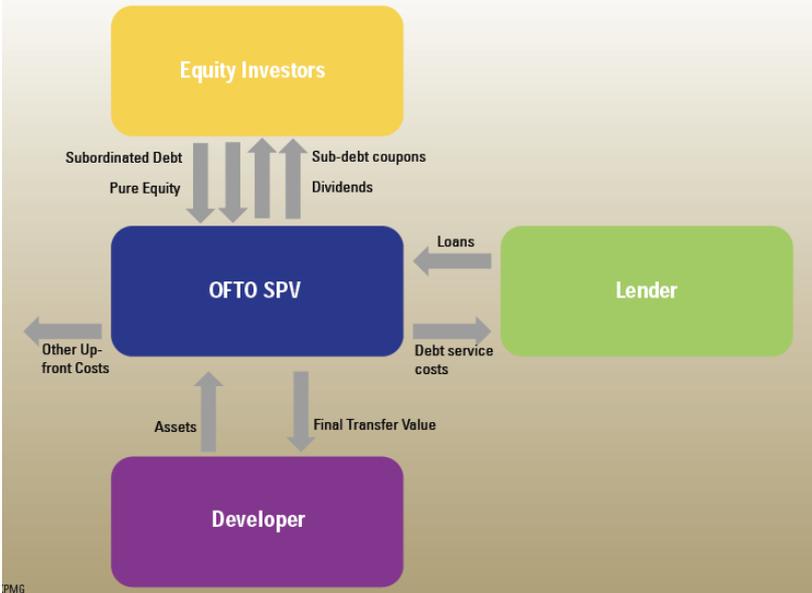


Figure 5: Example of a highly leveraged OFTO financing structure Source: (KPMG, 2014)

Table 18 provides a summary of the main financing and debt structure characteristics of most of the OFTO projects already licensed. The structure of the debts of the projects already licensed has been varied and solutions found for each projects are often composed of more than one type of debt. The use of bonds as a financing mechanism was first used by the Greater Gabbard project OFTO. This project was also the first recipient of the EIB’s Project Bond Credit Enhancement. At this time, Moody’s classified the credit rating of these bonds as (P)A3 (A-) (KPMG, 2014). In 2015, the licence attributed to the Gwynt y Môr project also used bond financing, which became the largest OFTO project to use this option (Ofgem, 2015).

Round	Project	Debt (£m)	Debt type	Gearing	Margin
1	Greater Gabbard	304	Bond issuance + EIB credit enhancement	87%	4.137% coupon (125 bps spread)
1	Sheringham Shoal	191	Term loan + £6m liquid facility	91%	LIBOR + 220 bps
1	Walney 2	109	Term loan + £5m liquid facility	87%	LIBOR + 240 bps
1	Robin Rigg	67	Term loan	84%	LIBOR + 200 bps
1	Gunfleet Sands 1 & 2	50	Term loan	84%	LIBOR + 195 bps
1	Walney 1	105	Term loan	85%	Not available
1	Barrow	35	Term loan	81%	LIBOR + 220 bps
2	Lincs	168	Not available	50%	LIBOR + less than 150 bps
2	London Array	419	Term loan + £3m liquid facility	85%	LIBOR + 220 bps (+ 240 bps by end of tenor)
2	West of Duddon Sands	255	Not available	85%	3.446% coupon (2027 gilts + 145bps)
2	Gwynt y Mor	339	Bond issuance + other mechanisms	87%	2.778% coupon (2025 gilts + 110bps)
3	Westermost Rough	155	Not available	83%	Not available

Table 18: OFTO debt financing terms for projects in Rounds 1, 2 and 3 (Source: (KPMG, 2014) (Cambridge Economic Policy Associates Ltd and BDO LLP, 2014))

5.3 OFFSHORE INTERCONNECTORS – EXAMPLES

When the interconnector project is the fully regulated model the financing structure is balance sheet financing and the developers of the project are the national TSOs meaning that the project is financed through the balance sheets of the national TSOs. There are also cases where apart from the TSOs other parties can also invest. This is the case of NordLink interconnector which is a joint investment of the Norwegian TSO Statnett and TenneT TSO GmbH and the German promotional bank KfW who are both responsible for the construction of the German part of the project, including permits (TenneT, 2017). In the case of merchant interconnectors separate companies invest and not the national TSOs of the interconnected countries. Hereafter, the example of the regulated interconnector COBRACable, a cross-border project of European significance which has designated as PCI is presented and the challenges encountered are investigated.

BritNed is a merchant interconnector between the UK and the Netherlands and has been in operation since 2011. The interconnector represented a significant link in furthering the development of the European transmission grid and played a critical role in EU's strategy to achieve a single European energy market. Thus, it serves as an interesting example to investigate the financial challenges experienced and lessons learnt.



COBRACable

COBRACable is an approximately 325 km long high voltage direct current (HVDC) subsea cable of around 700 MW capacity which will connect the Dutch and Danish electricity markets, as depicted in Figure 6. The purpose of COBRACable is to improve cohesion in the European transmission grid by increasing the exchange of surplus wind power with neighbouring countries and strengthen the infrastructure, security of supply and the market (Energinet.dk, 2015) . Furthermore, the connection will also be designed in such a way as to enable the connection of an offshore wind farm at a later stage. This will contribute to the realisation of a sustainable international energy landscape, a key aim of the European Union (TenneT, 2017a).

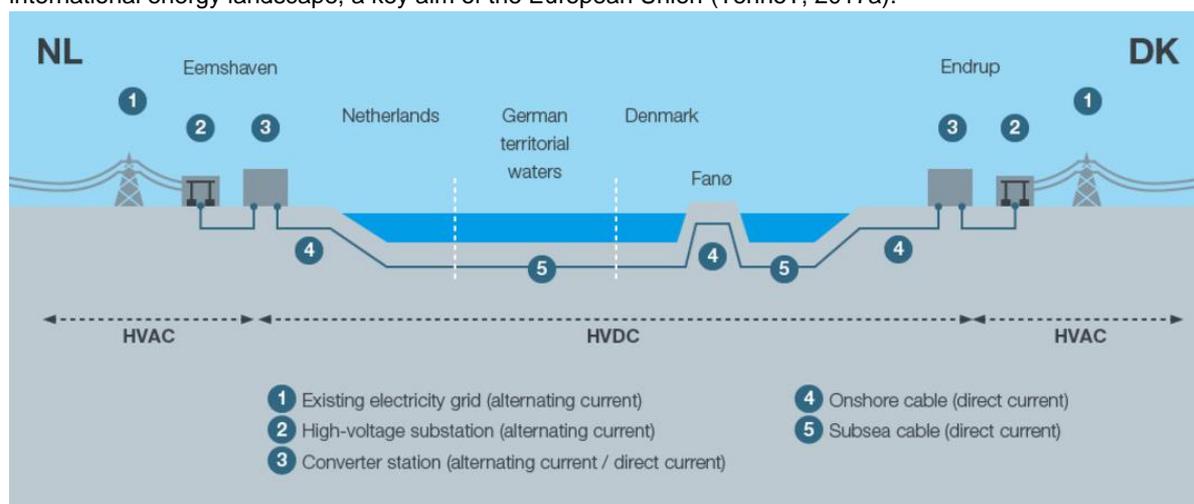


Figure 6: COBRACable-HVDC electricity connection between the Netherlands and Denmark via the German territorial waters. Source: TenneT’s website

TenneT TSO NL and Energinet.dk are the owners and operators of the COBRACable whose operational lifetime is estimated 40 years. The total investment cost for the entire project is EUR 621 million of which EUR 86.5 million is subsidy granted by the EEPR. The rest of the investment costs are shared 50/50 between TenneT and Energinet.dk (TenneT, 2013).

Table 19 shows the economic figures of COBRACable. It is noted that EEPR supports the construction, laying and connection of the cable, and the research and development activities on the new technologies which are necessary for the connection of wind farms to the cable (European Commission, 2013). The motivation for granting the subsidy to COBRACable is that the design of the interconnector considers the future connection of an OWF to the cable and thus, contributes to the development of a meshed North Sea grid (TenneT, 2013).

COBRACable interconnector	Investment costs
Total required budget	EUR 621 million
EEPR grant	EUR 86.5 million
Project promoters' contribution, 50/50 split	EUR 267 million, TenneT
	EUR 267 million, Energinet.dk

Table 19: Investment cost of COBRACable

The economic interest as well as the voting interest of each partner in COBRACable is 50%. In case of TenneT, COBRACable is financed through balance sheet financing. Liable for the interconnector project are the two TSOs.

The duration of the permitting phase was six years. The preparation for the permit application in all countries involved (the Netherlands, Denmark and Germany) started in 2010 and all permits were granted in 2016. The same year started the construction of COBRACable which is scheduled to be commissioned in the first quarter of 2019. During the permitting phase certain challenges encountered; severe discussions with relevant authorities regarding the shipping and nature interests took place. Difficulties with the German shipping authority regarding the route settlement at crossing Westereems was, partly, the cause of on-hold period 2012-2013. Difficulties were also encountered regarding cross-border coordination; the settlement on permit requirements with authorities in different jurisdictional borders was challenging, in particular the case of crossing of the Treaty area and Disputed area between the Netherlands and Germany. According to the developers of COBRACable the permit requirements for all jurisdictions are comprehensive and compliance with these requirements needs appropriate technical and managerial involvement. In particular the German permit requirements are extensive and strict. All of these issues led to substantial delays. Even though the interconnector holds the status of PCI and thus, benefits from favourable permitting conditions, the stakeholder managers of COBRACable perceived the coordination with the relevant authorities as very challenging; in some cases it was necessary to mobilise political powers to speed up the permitting procedure (information from TenneT).

BritNed

BritNed is a high HVDC interconnector which is situated between the Isle of Grain in Kent, in the UK, and Maasvlakte in Rotterdam, in the Netherlands, as depicted in Figure 7. The interconnector has a 260 km cable length with 1000 MW cable capacity.



Figure 7: High voltage interconnector BritNed location Source:

BritNed is a joint venture between the National Grid International Ltd and NLink International B.V. , a subsidiary of TenneT Holding B.V. . Both parties are 50% shareholder of Britned. The total cost of the development of this interconnector was EUR 600 million which was split as a 50/50 venture between the two companies. BritNed is a separate legal entity from the owners of the two national transmission systems that it connects, National Grid and TenneT, and thus, has full financial separation from them. It is assumed that the financial structure used behind BritNed is project finance, as the company produces a separate financial report each year and because it faces full liability should the interconnector fail (BritNed, 2015).

The revenue of the interconnector is based primarily on the cost spread between the two member states, UK and Netherlands.

BritNed is exclusively paid for by its users (i.e. participants of implicit and explicit auctions). All of BritNed's costs, including capital investment and operational expenditures, need to be covered by the auctioning of cable capacity. None of these costs are underwritten through regulated transmission charges.

BritNed began its first development works in 2001 where the planning phase began. A total of 10 years was taken from planning to commissioning phase. A permitting phase took place from 2001 to 2007 in which BritNed applied for regulation exemption.

BritNed requested an exemption from regulated third-party access to ensure a risk/reward balance for their investors. Under a regulated framework, both UK's and Netherlands's tariff regulation would limit the amount of revenue available to BritNed without covering the risk it was exposed to. Therefore, it was in BritNed's best interest to apply for an exemption from this regulation to attract more investment. Additionally, with the exemption, the interconnector's future capacity expansion would be at BritNed's discretion rather than being directed by the regulator. In all other respects the access arrangements would resemble that of a Regulated Third-Party Access (RTPA) regime.

In 2007, the European Commission granted a 25-year exemption, for the full capacity of the interconnector, from regulated third-party access. The European Commission raised the concern that BritNed might have undersized the capacity of the interconnector to artificially inflate congestion revenues. As a result, the commission requested that the NRAs amend their exemption decisions with the addition of a financial review after 10 years of operation. This review consists of BritNed providing total costs, total revenues and the rate of return using 2007 as a base year. In the case of the revenue exceeding that which was estimated at the time the exemption was put in place, BritNed has two options going forward; to increase capacity or cap any profits it has made. This is referred to as a 'de facto cap' regulating the amount of revenue the interconnector can have.

Complying with the three conditions for exemption from the regulatory requirements, as presented in Table 20, was a challenge for BritNed which consequently led to the agreement of the financial review every 10 years since development. The first financial review of BritNed will take place over 2017/18. Since the exemption being granted, there has been some reluctance in new projects which follow the steps of BritNed and instead have followed a cap and floor mechanism, such as Nemo interconnector. Investors have been deterred by a regulatory structure which threatens that they may be obliged to pay the entire costs and recoup a fraction of returns.



Conditions for regulatory exemption	Description
The interconnector must enhance competition.	A general competition analysis is conducted - the interconnector must show a positive effect on competition.
The risk level must necessitate an exemption.	The risks must rise to a level that rules out development of the interconnector as regulated investment.
Granting an exemption must leave competition unharmed.	Focus is on whether exempting the project from regulation would harm competition conditions.

Table 20: Three conditions for approval of an EU financial exemption for interconnectors Source: (Cuomo & Glachant, 2012)

5.4 SUMMARY

The investment volume of the European and national offshore network development plans poses a serious financing challenge. In particular the TSOs, which, in many countries, are obliged to connect the OWFs to the grid and meet the overall national investment plans, are influenced greatly from the investment volumes. Their financing structures and funding instruments are important parameters to ensuring the realisation of the European and national investment plans. Experience so far has shown that the TSOs are able to adjust their strategies to fit the offshore investments.

TenneT, the TSO with the largest offshore connection facilities in the Netherlands and Germany, managed to secure financing for the offshore grid projects in Germany through equity partnerships with private investors, while maintaining the majority of voting rights and leaving a certain part of the economic interest with the external investors. In parallel, TenneT managed to secure alternative funding by EIB and through the green bonds and recently the hybrid green bond with significantly low interest rates and long maturities.

In case of the OFTOs the structures are different. The OFTOs are privately owned and use a project finance structure. Their gearings are high, between 80%-90%, and historically mostly on long term loans. Bond financing is becoming a more common option. The Gwynt y Môr project used bond financing and became the largest OFTO project to use this option.

From these two examples is concluded that so far the offshore grid operators and owners, TSOs and OFTOs, have been able to adjust their financing structures, attract private investor and find alternative innovative funding for the offshore grid investments. It is has been also observed that the interest rates of the green bonds issued by TenneT were significantly lower than the ones issued by the OFTOs. It is assumed that the difference is related to the risk profile of the issuer; TenneT, raises debt at Holding level and can cover it with its entire balance sheet, thus, lenders provide better conditions. On the other hand, raising funding on a single-project basis, as is the case of the OFTO, involves higher level of risk and thus, higher cost of debt.

However, given the enormous volume of the investments needed and considering the uncertainties of debt conditions over the next 13 years, it is questionable whether the TSOs will continue to be able to realise the necessary investments under the current financing structures. Due to the current low interest rates, debt financing is the most favourable funding instrument at the moment, something which is also reflected on the high gearings of the offshore projects. However, an increase of the interest rates would have a negative effect on the TSOs' balance sheet, by increasing the cost of debt. In this case, an internal or/and external equity injection would be the most viable solution in the long run. However, additional equity injection from private



investors will be difficult to be implemented where the TSO is state owned and the Government, who is the shareholder, is not willing to dilute their rights and inject additional equity.

The experience with the interconnector projects shows that despite the fact that these investments are of pan-European significance and thus, they benefit from financial support from the EU and accelerating permitting procedures, still face significant challenges which impact the investment case. The example of COBRACable showed that despite the PCI status, which allow the investor to benefit from accelerating permitting procedures (including a binding time limit of 3.5 years for granting a permit (Regulation (EU) No 347/2013)), the administrative and regulatory complexity of multi-national projects can lead to significant delays in realising the investment.

BritNed is an interesting example of an interconnector that opted for a transmission capacity financial mechanism which would maximise the revenue under exemption. However, the fact that a regulated cap was developed to keep the revenue under certain limits made investors reluctant to invest in new merchant interconnectors and instead they have followed a cap and floor mechanism, BritNed published a response to the Cap and Floor regime during its consultation phase⁵. This response highlighted the initial challenges of structuring investment in interconnector infrastructure between the UK and the Netherlands. The Netherlands have a different regulatory approach, with the interconnector forming part of the regulated asset base and being primarily owned by the TSO. From the response it is clear that BritNed is encouraged by the new attempts to ensure the merchant interconnector model is catered for across interconnector regulation of different countries through the new cap and floor mechanism. BritNed addresses that the new regulatory regime should be stable and predictable creating the right investment incentives at the outset and during the lifetime of existing and new interconnector infrastructure. In hindsight, this new interconnector regulation could have worked well in the case of BritNed and would ensure correct balance of rewards and risks for their investors.

⁵ <https://www.ofgem.gov.uk/ofgem-publications/59320/britned-response-8611.pdf>



6 CONCLUSION

The development of a Northern Seas offshore grid is one of the key infrastructure projects to achieve the European energy targets by 2030. ENTSO-E estimates that the investment needs for a North Sea Grid by 2030 is EUR 100 billion. In its Communication, EC gives no information about an investment gap specifically in the offshore transmission networks but rather estimates that only the 50% of the required investments for energy transmission networks (gas and electricity) will be realised by 2020 leaving a financing gap of around EUR 100 billion. This investment challenge implies a significant financing challenge particularly for the TSOs and raises questions whether the TSOs will be able in the long run to carry out the enormous investment volumes required for a MOG. TSOs have to raise large volumes of debt and equity. The current low interest rates make debt financing the most favourable funding instrument at the moment, something which is also reflected on the high gearings of the offshore projects. Given that the investment momentum continues in the future, an increase of the interest rates would have a negative effect on the TSOs' balance sheet, by increasing the cost of debt. In this case, an internal or external equity injection would be the most viable solution in the long run. However, the option of equity injection from private investors will be difficult to be implemented where the TSO is state owned and the Government, who is the shareholder, is not willing to dilute their rights. It is also questionable whether the TSOs will still be able to attract the necessary private capital to finance the required offshore investments; if the interest rates increase the TSOs' investments would be in greater competition with other more favourable investments in the market and thus, the financing potential for the TSOs would be limited.

To this end, the regulatory framework should allow a sufficient rate of return to guarantee that the network operators are in a position to take on the large investments required in the offshore electricity transmission grids and to acquire the necessary capital according to the rules and conditions of the market. However, in the current regulatory frameworks the national regulators offer the same rate of return for all types of investments without distinguishing between onshore and offshore electricity transmission investments. Furthermore, there is a clear trend to decreasing the rate of returns due to the low interest rates seen in the capital markets. However, if the investment environment changes, i.e. increase of the global and European interest rates, and given that the rate of return is fixed, in most regulatory regimes, within a certain regulatory period, it is questionable whether the current national regulatory frameworks will be still sufficient to facilitate key investments in cross-border offshore transmission projects.

The OFTOs in the UK has been so far an attractive financial model for offshore grid investments, being privately owned entities which operate independently from the onshore transmission system with a fixed 20-year revenue stream. The OFTOs use high leveraged project finance structures with bond financing becoming a more common option. However, should the interest rates increase in the future and given that raising funding on a single-project basis, as is the case for the OFTO, involves higher risk, the cost of debt would increase significantly raising doubts about the feasibility of this financial model.

In the case of offshore interconnectors, the regulated model doesn't provide sufficient incentives for investments and in UK even failed, since the national regulator imposes limitations on National Grid to recover interconnector costs from customer tariffs. The merchant approach might not be a good alternative financial



model in the long term. The revenue of the merchant interconnectors is determined solely by a market mechanism. Should the interconnectivity among the countries surrounding the North Sea increase in the future leading to a convergence of the market prices, the revenue of the interconnector would decrease significantly making the merchant approach not feasible. The Cap and Floor regime comes to answer the concerns of investors that the creation of additional interconnectors will lead to a convergence of the prices at the different markets and hence, to a sharp decrease in revenues, by ensuring a minimum level of revenue (floor). However, an increase in the level of interconnectivity in the North Sea in the future would mean a convergence of market prices and consequently significant decrease of the congestion rent which is the primary income of interconnector investors. In addition to this, if the cost of capital (interest rates) increases in the future it is questionable whether the current “floor” level would be still sufficient to compensate the investors.

Due to the enormous investment volume required, public funding for key cross-border electricity transmission projects is necessary. Especially, for offshore interconnector projects, whose profitability depends mainly on the price difference between two markets, it should be considered to what extent the envisaged grid infrastructure in the Northern Seas can be funded on a purely market-driven basis (EWEA, 2014). The EU has developed a number of policies and funding mechanisms, such as the PCIs and CEF, to support and stimulate investments in offshore interconnectors and fill the investment gap. However, despite the fact that PCIs benefit from accelerating permitting procedures, the administrative and regulatory complexity of multi-national projects can still lead to significant delays in realising the investment. CEF’s annual budget for PCIs covers only 10%-13% of the annual average investment needs for transmission and interconnection. This raises doubts whether the current EU financial instruments and tools would be sufficient to support investments in a MOG in the North Sea when the market alone cannot deliver them. Furthermore, should the interest rates increase, it is questionable whether the current EU funding mechanisms would be able to mobilize and attract the required private capital for investments in a MOG.

The demand for the enormous capital to realise a European MOG in the North Sea in addition to the identified obstacles to this investment, require the development of sustainable strategies for financing. Hereafter, some initial ideas for the further discussion on the recommendations for possible strategies are presented:

- In cases where the TSO is state-owned and the Government is reluctant to inject further equity alternative ways should be found to enable private equity participation to avoid increasing requirement for debt financing, which would lead to higher leverage, a lower TSO credit rating and thus, higher financing costs. Allowing for private equity participation, e.g. in a TSO substructure, such as mini-TSOs, or a tender system for the construction of transmission assets, could be possible solutions.
- The financial market conditions should be reflected in the regulatory frameworks for offshore transmission investments in order to enable the TSOs to attract capital according to the rules of those markets. The regulatory framework should be flexible and sufficiently adapted so that the TSO revenue can cope with future uncertainty. The regulatory regime should allow a flexible adaption to changing capital market conditions, i.e. a significant change of the interest rates.
- The regulatory frameworks should recognise the higher risk involved in offshore transmission investments and create the right incentives for the TSOs to take up the investment challenge. A distinction should be made between - lower risk - onshore and - higher risk - offshore transmission systems.



- Due to the intended electricity price convergence in the European Single Market, supported by the EC target for 10% interconnectivity by 2020, the revenue of merchant interconnectors will be impacted negatively. Another model for remuneration should be developed, different from the congestion rent mechanism.
- The concrete implementation of the PCI policy with regard to the permitting procedures (a binding time limit of 3.5 years for granting a permit) should be improved in order to avoid substantial project delays.
- An increase of the available EU budget (e.g. CEF) could be an appropriate way to facilitate and accelerate investments in a MOG.

Further research on the financing practices of international electricity grids and major infrastructure projects will be conducted. The major financial barriers for investing in a MOG in the North Sea and the level of risk these barriers impose to investors will be thoroughly investigated. The results of the overall analysis along with the existing European financing models and strategies applied to the offshore electricity transmission investments will be taken into account in order to identify best practices and provide a concrete set of recommendations for developing a *financial framework for MOG grid investments*.



7 LIST OF ABBREVIATIONS

Terms	Abbreviations
Capital Expenditures	CAPEX
Copenhagen Infrastructure Partners	CIP
European Commission	EC
European Investment Bank	EIB
European Union	EU
Greenhouse gas	GHG
Meshed offshore grid	MOG
National Electricity Transmission System Operator	NETSO
National Regulatory Authority	NRA
Offshore Grid Development Plan	O-GDP
Offshore substation	OSS
Offshore Switch Yard	OSY
Offshore transmission owner	OFTO
Offshore wind farm	OWF
Operational Expenditures	OPEX
Regulatory asset base	RAB
Renewable energy	RE
Renewable energy sources	RES
Return on equity	ROE
Special Purpose Vehicle	SPV
Total Expenditure	TOTEX
Transmission system operator	TSO
Weighted average cost of capital	WACC

Table 21: List of abbreviations



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